REMARKS/ARGUMENTS

In response to the Office Action mailed February 4, 2004, the Applicants respectfully request reconsideration of the outstanding rejections and allowance of all claims in light of the foregoing amendments and the following explanations and arguments. These amendment have been made by way of clarification and do not limit the claims except as reasonably understood by their plain language in accordance with the following explanations.

Claims 3 and 4 stand rejected under 35 U.S.C. § 112, second paragraph, as being indefinite. Accordingly, the term "upconversion" has been changed to "downconversion" to correct a typographical error.

Claims 1-27 stand rejected over art of record. Claims 5-8, 10, 11, 12, (13), and 27 stand rejected under 35 U.S.C. 102(b) over U.S. Patent No. 5,860,057 to Ishida, a reference cited by the Applicants.

Claims 1-4, 9, and 14-26 stand rejected under 35 U.S.C. 103(a) over U.S. Patent No. 5,860,057 to Ishida in view of U.S. Patent No. 6,330,290 to Glas, a newly-cited reference. The Applicants note and wish to call attention of the Examiner to a reference cited in Glas, namely, James K. Cavers, "Adaptive compensation for imbalance and offset losses in direct conversion transceivers," *IEEE Transactions on Vehicular Technology,* 42(4):581-588, Nov. 1993, a copy of which is enclosed. As will be clear hereinafter, the Glas reference is less relevant than the Cavers reference, and the problem addressed by the present invention remained heretofore unsolved and would remain unsolved but for the present invention.

The Examiner has applied Ishida to all claims. Ishida had been cited originally by the Applicants because it is a general reference to a spectrum sharing technique involving matching of amplitude and phase characteristics of a presumably ideal signal frequency downconverter and signal frequency upconverter in a shared frequency channel. It does not contemplate the presence of real-world imperfections addressed by the present invention. The present invention as claimed clearly distinguishes over the art represented by Ishida.

Glas describes digital in-phase/quad-phase imbalance compensation for effects created solely by the splitter in the LO path. It contains nothing to suggest any application of its techniques in the unique environment of spectrum sharing of free-space radio frequency signals. By comparison, Cavers describes an analytical technique and a technique of adaptive compensation for the entire quadrature modulator of an I/Q upconverter configuration at a transmitter and the entire quadrature modulator of an I/Q downconverter at a receiver. This reference is arguably more relevant to the present invention than Glas, since its explanation of compensation is more comprehensive than Glas. Nevertheless, both references are deficient for, among other reasons, their failure to teach modeling of the upconverter and downconverter in a self-interference removing receiver. Cavers had been known in its art for almost ten years at the time of the filing of the present patent application and likewise contains nothing that it would suggest its use in the challenging environment of spectrum sharing of R.F. signals where one of the sources of undesired interference is the signal generated *locally* and then included in a *received* composite signal. Although the art recognizes the issue of imperfections in real converters and the value of converter compensation, heretofore no one has recognized that the environment of spectrum sharing produce compensatable magnitude and phase errors or even that the up and down conversion processes themselves produce magnitude and phase errors, where both of which must be modeled and preferably perfectly compensated for in the process of removal of self-interference.

In the prior art, Ishida discloses a process of removal of self interference. Work done under the auspices of the assignee of the present invention discloses a process of self interference cancellation. However, nothing in the disclosure of Ishida or in the prior work of the assignee suggested or taught how to overcome the problems associated with errors introduced by non-ideal components. In fact, heretofore, the solutions to this problem have involved inefficient workarounds wherein the accounting for the downconversion imperfections and upconversion imperfections in the components has merely been included in the calculations of the link budget error margins as uncompensated-for noise!

With this background, the Applicants respectfully submit that claims 5-8, 10-13 and 27 are not anticipated by Ishida, and that claims 1-4, 9, and 14-26 are not rendered obvious by the combination of Ishida and Glas or even in combination with Cavers.

Referencing Ishida, the Examiner has cited this as a primary reference as containing "modeling upconversion imperfections," referring to Figure 6 elements 1, 10, 11, and 12 (BB data, delay unit, carrier recovery, and modulator) and column 7, line 52 to column 8, line 5.

The Applicants respectfully challenge this analysis of the Examiner. First, the elements in Figure 6 are not concerned with modeling upconversion imperfections; they are provided merely to re-create the component of the composite received signal that is due to the subject unit's own *ideal* transmission. Note that there is no mention in Ishida of the imperfections of the modulator 2 or upconverter 3.

Second, a relevant portion of the cited section, namely column 7, line 66 through column 8, line 5, teaches away from the claimed invention. It states:

"The modulator 12 modulates like in the transmission system the carrier (S'H) inputted from the carrier reproducing circuit 11 with the transmission bit train (S'H) inputted from the delay (memory) circuit 10 to thereby generate a modulated wave for local transmission wave canceling signal generation which is inputted to the amplitude/phase control circuit 13."

Significantly, this statement *assumes* that the modulation in the cancellation portion is *exactly the same* as the modulation in the original transmit chain. The only place where the signal is adjusted is the amplitude and phase adjuster element 13 of Figure 6.

Referring further to Ishida, column 8, lines 6-11:

"The amplitude/phase control circuit 13 controls the amplitude and phase of the modulated wave for local transmission wave canceling signal generation to make the modulated wave have the same amplitude as, and the opposite phase to, those of the local transmission signal components (S'H) contained in the reception signal."

This amplitude and phase control is known within the art as being needed to match the locally-generated replica with the incoming signal. However, such an adjustment has nothing to do with the *additional* step of modeling and canceling the *upconverter* imperfections

which are present on account of the return of the locally-generated signal as part of the received composite signal.

To this end, the claims have been amended to emphasize these distinctions and to add clarity to the statement of invention. For these reasons, the Applicants submit that Ishida fails as a reference to anticipate claims 5-8, 10-13 and 27. It is submitted that these claims, particularly as amended, define patentable subject matter.

Claims 1-4, 9, and 14-26 stand rejected under 35 U.S.C. §103(a) over Ishida in view of Glas. The examiner has evidently cited Glas against those claims that specifically relate to the employment of modeling of downconversion errors. The Examiner did not cite that this reference also describes a technique for compensation for upconversion errors. See column 7, lines 60-65:

"In accordance with one embodiment of the invention, transceiver 10 employs the same local oscillator and phase splitter for both receive and transmit branches. To this end, the measured imbalance errors will not only represent the imbalances from the receiving branch, but also from the transmitting branch. For this reason, the method of imbalance measurement in accordance with this embodiment of the invention can only be applied if the imbalance errors are dominated by phase-splitter units. In that case it can be assumed that the measured imbalances are twice the actual values due to imbalance caused in the up-conversion transmitting branch and the imbalance caused in the down-conversion receiving branch."

The apparatus of Fig. 2 therein can be used for this purpose if components 20 and 118 are the same actual unit.

Moreover, while not noted in Glas, the apparatus of Fig. 2 of Glas can be used for both upconverter compensation and downconverter compensation but only **IF** the same type of system is used at both ends. Recognition of this feature is relevant to recognition of one of the huge differences between the Glas reference and the present invention:

A system constructed according to the Glas invention must use a training period because there is no other way to determine the errors. By contrast, the present invention admits to truly adaptive operation, as it can operate without training and requires no training period, and nowhere in the specification is training suggested.

The Cavers reference is a better overview of the state of the art in modeling converters. However, even in Cavers, there is a lack of teaching applicable to the claimed invention. For example, Cavers teaches away from handling upconverter errors *at the receiver*. Errors, if any, are handled *only at the transmitter*.

To demonstrate impermissible hindsight reconstruction by the Examiner, the Applicants offer this brief analysis. Compare Figures 6 and 8 of Ishida to determine if corresponding components can be identified in Figure 1 of the present application. The attempt to do so is a nontrivial exercise. In order to do so, an equivalent of element 36 of the applicants' Figure 1 must be found. The detail of element 36 corresponds to Figure 7 of the present application. No feature of Ishida can in any way be correlated to Figure 7. Hence Ishida cannot be adapted to operate in combination with Glas. Further, even if Glas were able to be combined with Ishida, the combination would not produce the intended result. Glas lacks the requisite suggestion for compensating for conversion errors in the upconverter as well as the downconverter. One might turn to Cavers for this purpose, but it too lacks such a suggestion.

In summary, neither of the applied references anticipates nor in combination actually suggests the present invention. Ishida teaches away from the invention in that it describes self-interference removal without ANY converter compensation. Glas, although it describes compensation, its description is of a technique that differs substantially from that claimed. And is in not in the same environment; it lacks any teaching providing ability or motivation to combine it with Ishida. Even in combination, the Glas and Ishida reference do not teach the claimed invention, particularly respecting those claims related to modeling.

An Information Disclosure Statement accompanies this submission to assure that the Cavers reference is made of record. The Jones reference is also noted as being of record. The Applicants feel it is not applicable to the claimed invention.

CONCLUSION

In view of the foregoing, it is respectfully submitted that all claims, particularly as amended, define patentable subject matter. Allowance of all claims is respectfully requested.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 650-326-2400.

Respectfully submitted,

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